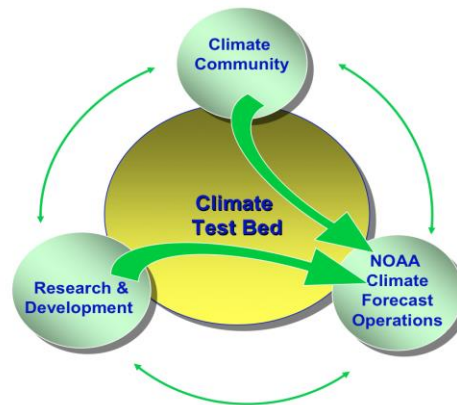


NCEP Climate Test Bed (CTB) as Development Test Center for ISI

Jin Huang
August 1, 2013



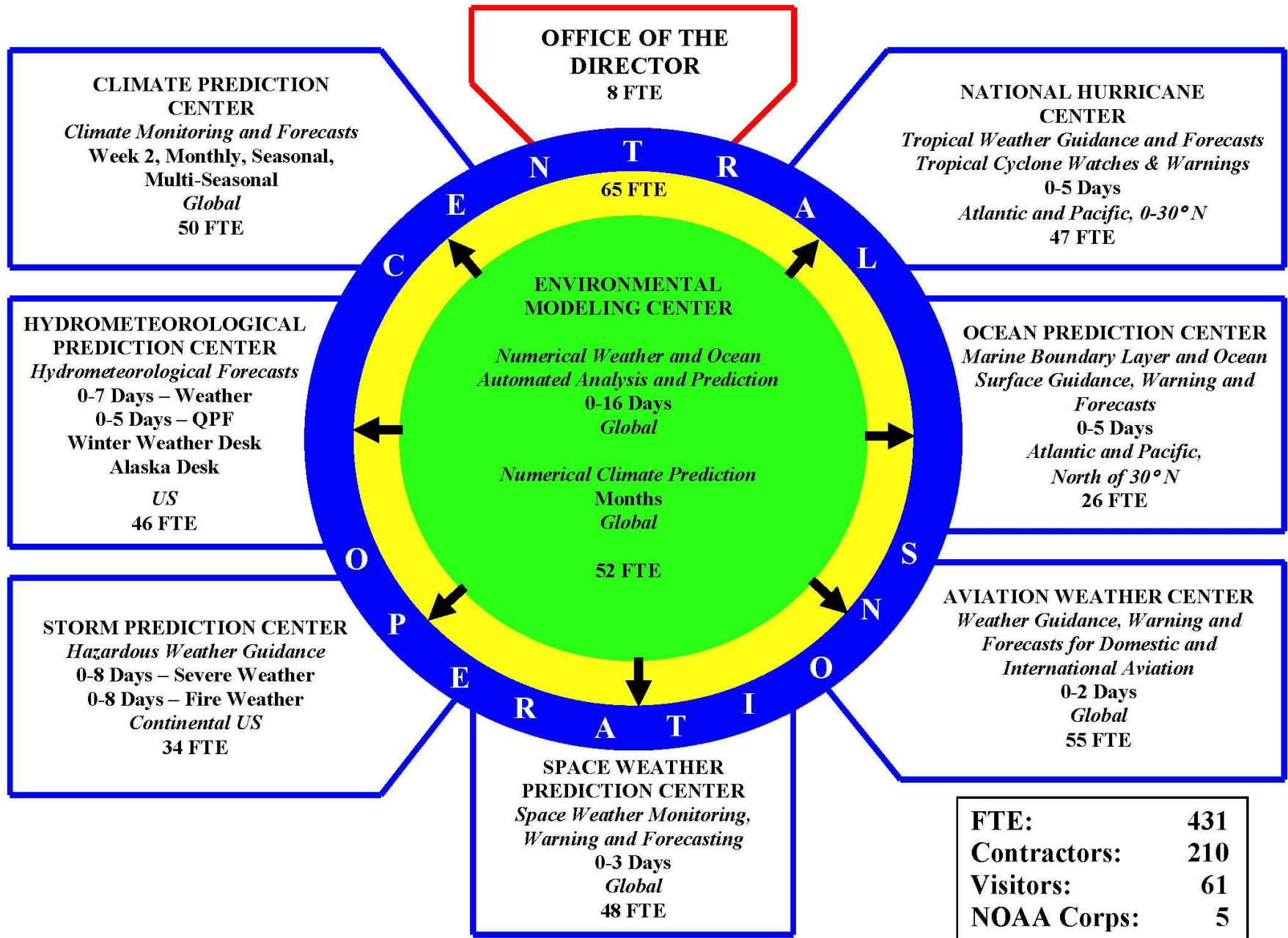
Mission: To accelerate the transition of scientific advances from the climate research community to improved NOAA climate forecast products and services.

<http://www.cpc.ncep.noaa.gov/products/ctb/>

Outline

- CTB's mission and organization structure
- Current priorities and activities
- Evaluation metrics for CTB R2O transition

NATIONAL CENTERS for ENVIRONMENTAL PREDICTION





NCEP Test Beds

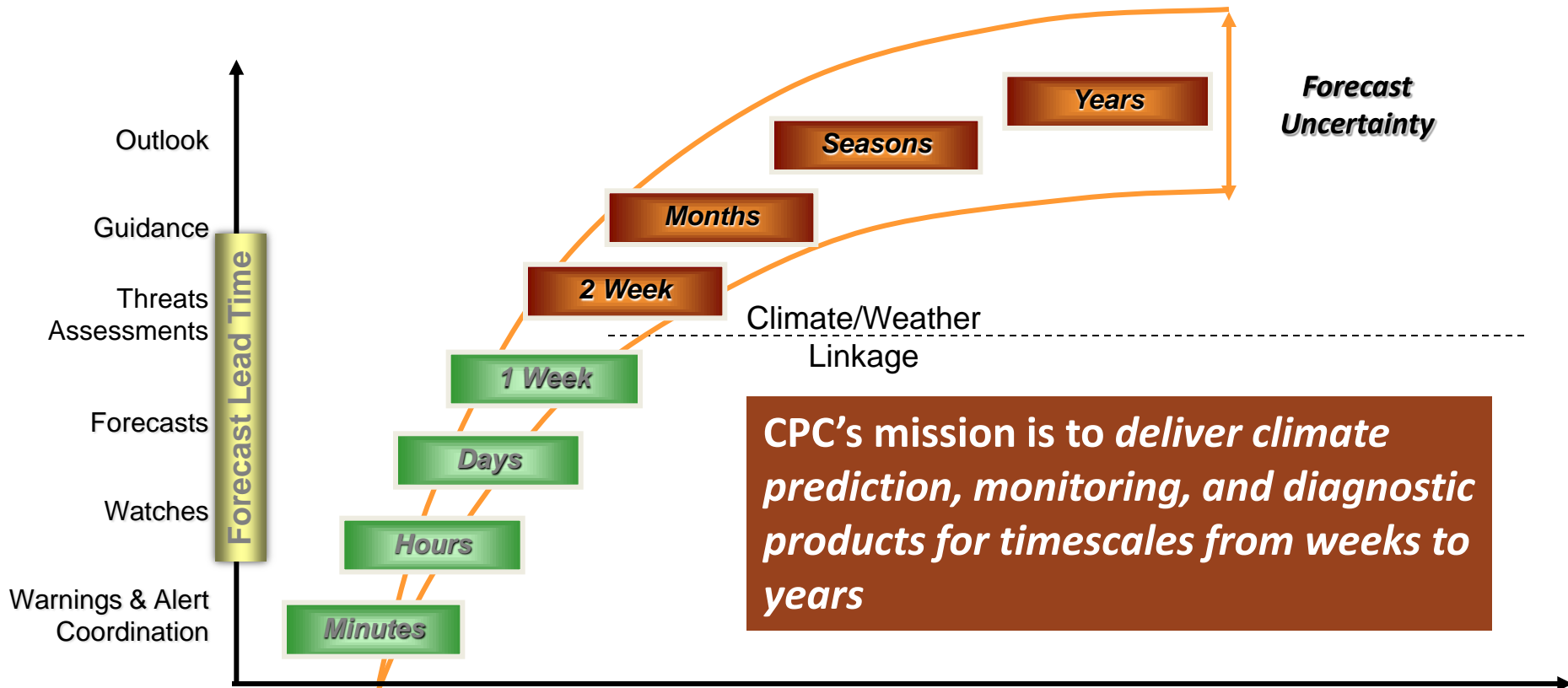
Service – Science Linkage with the Outside Community:
Accelerating the R2O Transition Process



- EMC WRF **Developmental Test Center (DTC)**
Joint Center for Satellite Data Assimilation
- **CPC Climate Test Bed**
- NHC Joint Hurricane Test Bed
- HPC Hydrometeorological Test Bed
- SPC Hazardous Weather Test Bed with NSSL
- SWPC Space Weather Prediction Test Bed with AFWA
- AWC Aviation Weather Test Bed
- OPC IOOS Supported Test Bed (in discussion
with NOS/IOOS)

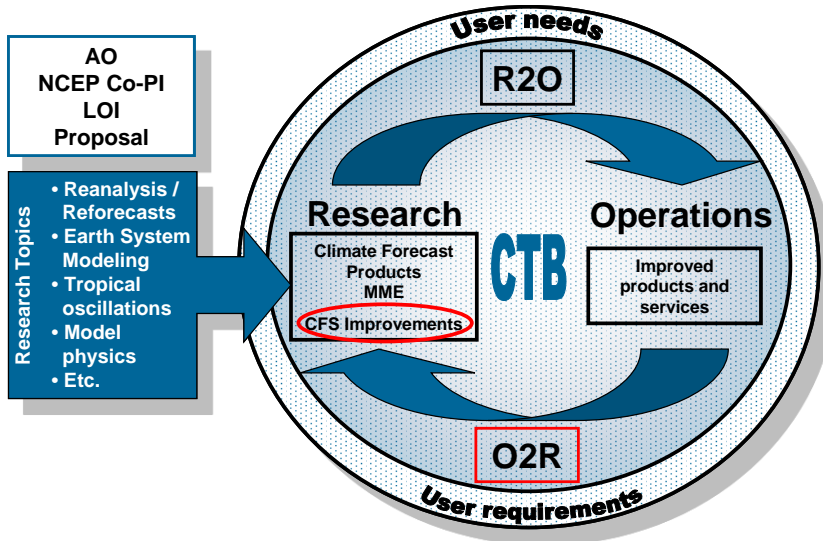


CTB Contributions to NOAA Seamless Suite of Forecast Products



- CTB's mission is to improve *climate forecast products and service on timescales from weeks to years by accelerating R2O transitions.*
- CTB priorities are driven by the requirements of NOAA operational forecasts

NCEP Climate Test Bed



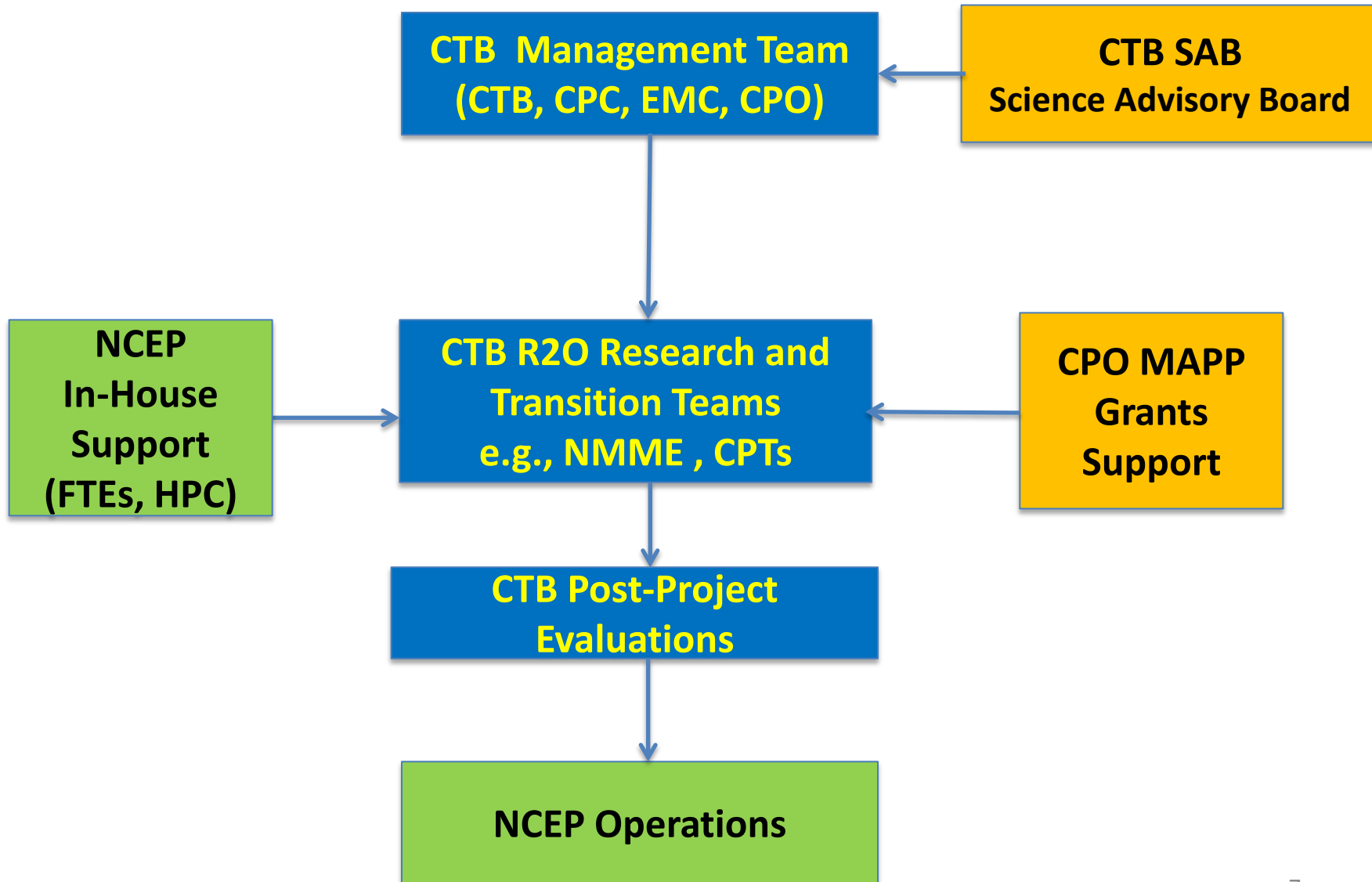
Mission

To **accelerate the transition** of scientific advances from the climate research community to improved NOAA ISI climate forecast products and services.

- Joint NCEP-CPO facility @ NCEP
- CTB Science Advisor Board (SAB)
- Established in 2005
- Serves as conduit between the operational, academic and research communities

- CTB embraces *the R2O and O2R paradigms*
- *Grants projects sponsored by Climate Program Office*
- CTB emphasizes three science activities
 - *CFS improvements*
 - *Multi-model ensembles*
 - *Climate forecast products*

How Does CTB Function?



CTB Priority (1): Multi-Model Ensembles

Goal: A multi model ensemble prediction system that leverages the best national and international models for improved predictions on intraseasonal-to-interannual time scales

NMME Phase-I

- An experimental system initiated as part of a MAPP/CTB research project in FY11.

NMME Phase-II

- An improved experimental system as a part of a FY12-FY13 MAPP/CTB research project with additional support from NSF, DOE and NASA

Future CTB NMME Plan:

- Evaluate NMME-based Hurricane Seasonal Outlook
- Develop a strategy to operationalize NMME
- Develop intra-seasonal forecast protocol
- Develop a 5-year plan to enhance NMME system capabilities (multi-agency effort)

- Provide NMME real-time forecast for CPC monthly and seasonal operational forecast
- Provide NMME hindcast and real-time forecast data to the community

NMME current Partners

- University of Miami
- COLA
- NCAR
- IRI
- U of Colorado/CIRES
- NASA/GMAO
- NOAA/NCEP
- NOAA/GFDL
- Princeton U
- Canada

NMME Phase-I Protocol

(for monthly/seasonal forecasts)

- 1. Real-time prediction system must be identical to hindcasts system**
- 2. Hindcast start times must include all 12 calendar months**
 - Ensemble generation strategy is left open.
- 3. Lead-times up to 7 months are required - longer leads are encouraged**
- 4. The target hindcast period is 30 years (typically 1981-2010)**
- 5. All model outputs on 1x1 grid**
- 6. The ensemble size is left open - larger ensembles are encouraged**
- 7. Data distributed includes each ensemble member**
 - Total fields are required
 - Systematic error corrections to be coordinated by NOAA/CPC
 - Forecast providers are welcome to also provide bias-corrected forecasts and to develop their own MME combinations
- 8. Required output is monthly means of global grids of SST, T2m, and precipitation rate**

Developing NMME Protocol for Intra-Seasonal

- **Build on the NMME monthly/seasonal forecast system**
- **Test different protocols;**
- **Factors to be considered:**
 - How often are the forecasts initialized? Is daily initialization required? Is weekly good enough?
 - How quickly is forecast available after initialization time?
 - How long? 45 days?
 - CPC has plans for experimental forecast for weeks 3 & 4. Need to define protocol with operations in mind.

A virtual mini-workshop on NMME intra-seasonal forecast protocol is in planning (K. Pegion et. al.)

CTB Priority (2):

CFS Evaluation and Improvements

- To accelerate evaluation of and improvements to the operational Climate Forecast System (CFS) and to enhance its use as a skillful tool in providing NCEP's climate predictions and applications

Recent CTB activities:

- CTB funded modeling projects
- Establishing metrics for evaluating improvements in NCEP climate model.
- Special Issue on CFSv2 Evaluations in Climate Dynamics
- Development of CFSv3 Strategy

Recently funded CTB Projects for NCEP GFS/CFS improvements:

1. **Climate Process Team** to improve cloud and boundary layer processes in GFS/CFS (**Bretherton**, Teixeira, Golaz, Pan)
2. **Climate Process Team** for Improving Turbulence and Cloud Processes in the NCEP Global Models (**Krueger**, Moorthi, Pincus, Randall)

CTB Priority (3):

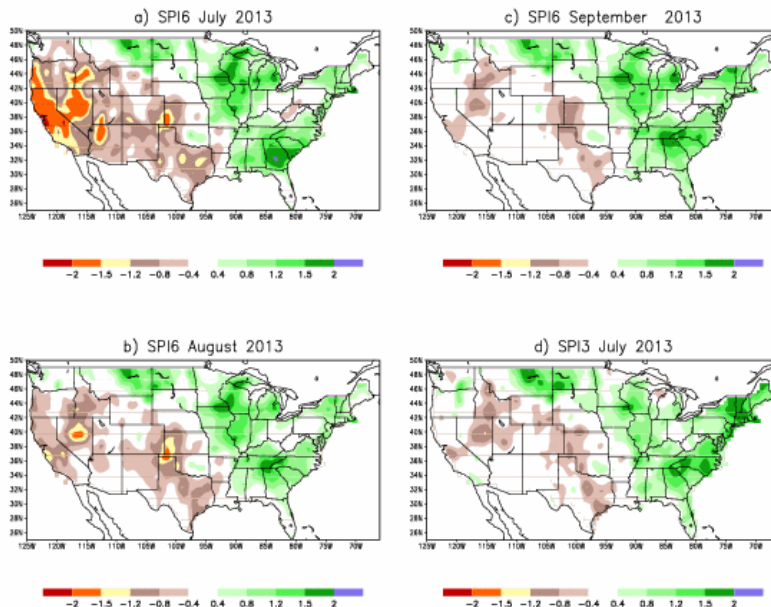
Improving Climate Forecast Tools/Products

Goal To provide reliable climate forecast products that are responsive to the needs of users and incorporate state-of-the-art science and research



NMME-based drought forecast (after Kintse Mo)

NMME SPI Fcst (ICs=July 2013)



Development of MAPP Drought Assessment Protocol

- Guidance for CPO/MAPP PIs to address “*Is my research effort improving upon current capabilities to monitor or predict drought, and by how much?*”
- Assessment metrics for drought monitor and forecast
- Verification data
- Verification period and case studies
- Baselines and benchmarking

Metrics in Drought Assessment Protocol

Key predictand (s) for drought variable (e.g., P, T, soil moisture, streamflow)	Metric(s) and skill scores comparing
Onset and recovery of drought condition	Lead time of prediction Error of identification
Duration and severity of drought condition	Error, bias, correlation (time, value)
Indication (detection, prediction) of drought condition: deterministic	Categorical metrics: Critical Success Index (CSI), Equitable Threat Score (ETC) Probability of Detection (POD), False Alarm Rate (FAR), and others.
Probability of drought condition: probabilistic	Brier Skill Score (binary); secondarily, Brier decompositions for reliability and resolution
Value, overall Value given drought occurring in the observed or forecast period	1. Error, bias, correlation (of ensemble mean or median for probabilistic) 2. Ranked Probability Score (CRPS)

Verification period and case studies

- Winter 2001-Spring 2002 severe western US drought event.
- Fall 2005-Summer 2008 sustained southeast US drought period
- The 2010- 2011 water-year drought over the Southern Plains,
- The 2012 summer flash drought over the Central Great Plains.
- Forecast capability evaluation over a **30-year (1981-2010) period** or longer is encouraged

Requirements to Select and Manage MAPP-CTB Projects

- MAPP-CTB proposals must include a section with **metrics** to be used to evaluate the outcomes of the project and assess readiness for transition into NCEP's operations.
- MAPP-CTB proposals must include co-PIs or collaborators from NCEP.
- MAPP-CTB proposals must include a **support letter from NCEP** (CTB, CPC and EMC).
- Post-Project Reviews

NCEP Metrics for Climate Model Evaluations

- **AMIP and CMIP Simulations Diagnosis:**
 - Mean bias (surface temperature; precipitation; T, u, v in the free atmosphere)
 - Modes of variability (PNA, NAO,...)
 - MJO; wind shear in Atlantic
 - ENSO tele-connection
- **Initialized predictions**
 - **Weather forecasts:** using EMC Verification Package
 - Anomaly correlations, biases, RMSE (u, v, T, P, SLP, q, cloud)
 - hurricane track and intensity errors
 - **ISI time forecast:** P, T and ENSO forecast skills.

Climate Forecast Evaluation Metrics and Protocol

The forecast evaluation metrics are for evaluations after the model development is finalized and hindcasts over the appropriate period are available.

Forecast Evaluation protocol for monthly/seasonal forecasts: (following NMME protocol):

Hindcast period:

- minimum 30 years (1982-2012)

Forecast lead time:

- 1- 9 months

Number of ensemble members:

- To be decided by the tool developer

Basic data:

- Monthly mean of T2m, Prate, Z200 and SST

Data requirements:

- Include each ensemble member and total uncorrected fields.
- Data format: Grid 1x1
- Domain: Global

Metrics:

Deterministic/Continuous :

- Anomaly Correlation (AC)
- Root Mean Square Error (RMSE)
- Mean Absolute Error
- Amplitude
- Biases

Categorical:

- Contingency Table
- Heidke Skill Score

Probabilistic:

- Brier Skill Score (BSS)
- Rank Probability Skill Score (RPSS)
- Reliability

Summary

- CPC develops, verifies and disseminates official climate forecast products for ISI time scales.
- CPC operational forecast system and NMME provide an platform for model inter-comparison and evaluation in an operational setting
- CTB is a NCEP test bed dedicated for testing and improving ISI climate forecast and products
 - Need dedicated FTEs (as other testbeds, e.g.JCSDA, DTC) to better serve broader stakeholders and users